

CLAIMS

I claim:

[c1] 1. A fire-suppression system for use in an aircraft having a cargo compartment, comprising:
 at least one fire-suppressant vessel;
 a discharge conduit coupled to the at least one fire-suppressant vessel;
 and
 a valve arrangement coupled to the at least one fire-suppressant vessel and the discharge conduit, the valve arrangement having a first setting to discharge a fire suppressant to the cargo compartment at a first discharge rate upon activation of the fire-suppression system, a second setting to discharge the fire suppressant to the cargo compartment at a second discharge rate less than the first discharge rate, and a third setting to discharge the fire suppressant to the cargo compartment at a third discharge rate greater than the second discharge rate during descent of the aircraft.

[c2] 2. The system of claim 1, further comprising a first pressurized container that contains at least a first portion of the fire suppressant, a second pressurized container that contains at least a second portion of the fire suppressant, and a third pressurized container that contains at least a third portion of the fire suppressant.

[c3] 3. The system of claim 1 wherein the fire suppressant is Halon.

[c4] 4. The system of claim 1 wherein valve arrangement is adjustable to provide at least the first, second, and third discharge rates of the fire suppressant.

[c5] 5. The system of claim 1 wherein the valve arrangement includes a first flow control device coupled to the discharge conduit to control a flow of the fire suppressant at the second discharge rate, and a second flow control device coupled to the discharge conduit to control at least a portion of a flow of the fire suppressant for dispersal at the third discharge rate.

[c6] 6. The system of claim 1 wherein the valve arrangement is configured to discharge the fire suppressant at the first discharge rate over a first period of time, to discharge the fire suppressant at the second discharge rate over a second period of time greater than the first period of time, and to discharge the fire suppressant at the third discharge rate over a third period of time less than the second period of time.

[c7] 7. The system of claim 1 wherein the valve arrangement is configured to discharge the fire suppressant at the third discharge rate only during descent of the aircraft.

[c8] 8. The system of claim 1 wherein the valve arrangement is configurable to discharge the fire suppressant into the cargo compartment at the second discharge rate to provide a fire suppressant concentration in the cargo compartment, and wherein the valve arrangement is configurable to discharge the fire suppressant into the cargo compartment at the third discharge rate to provide the fire suppressant concentration during the descent of the aircraft.

[c9] 9. A fire-suppression system for use in an aircraft having a cargo compartment, comprising:
 a first vessel containing fire suppressant dischargeable into the cargo compartment during operation of the fire-suppression system;

a first flow control device coupled to the first vessel and positioned to control a first flow of fire suppressant into the cargo compartment at a first discharge rate;

a second vessel containing fire suppressant dischargeable into the cargo compartment; and

a second flow control device coupled to the second vessel and positioned to control a second flow of fire suppressant into the cargo compartment along with the flow of fire suppressant from the first vessel, the first and second flows of fire suppressant being combined for simultaneous discharge into the cargo compartment at a second discharge rate greater than the first discharge rate during descent of the aircraft.

[c10] 10. The system of claim 9 wherein at least a majority of the fire suppressant from the second vessel is discharged only during the descent of the aircraft.

[c11] 11. The system of claim 9 wherein the fire suppressant is Halon.

[c12] 12. The system of claim 9 wherein the first flow control device is activatable to discharge the fire suppressant from the first vessel over a first period of time, and the second flow control device is activatable to discharge the fire suppressant from the second vessel over a second period of time less than the first period of time.

[c13] 13. The system of claim 9, further comprising a controller coupled to the first and second flow control devices, the controller being configured to activate at least the second flow control device to cause a generally continuous discharge of the fire suppressant from the second vessel during at least a majority of the descent of the aircraft.

[c14] 14. A fire-suppression system for use in an aircraft having a cargo compartment, comprising:

at least one fire-suppressant vessel containing a fire suppressant dischargeable into the cargo compartment;

a discharge conduit coupled to the at least one fire-suppressant vessel;

a controller coupled to the at least one fire-suppressant vessel, the controller being configured to cause discharge of a first portion of the fire suppressant into the cargo compartment over a first period of time upon activation of the fire-suppression system, the controller being configured to cause discharge of a second portion of the fire suppressant into the cargo compartment at a first rate and over a second period of time greater than the first period of time, and the controller being configured to cause discharge of a third portion of the fire suppressant into the cargo compartment at a second rate greater than the first rate and over a third period of time less than the second period of time during descent of the aircraft.

[c15] 15. The system of claim 14 further comprising a valve arrangement coupled to the discharge conduit and to the controller.

[c16] 16. The system of claim 14 wherein the fire suppressant is Halon.

[c17] 17. The system of claim 14 wherein at least a majority of the third portion of the fire suppressant is discharged only during descent of the aircraft.

[c18] 18. A fire-suppression system for use in an aircraft having a cargo compartment, comprising:

a first fire-suppressant vessel assembly configured to discharge fire suppressant into the cargo compartment at a first discharge rate upon activation of the fire-suppression system;

a second fire-suppressant vessel assembly configured to discharge fire suppressant into the cargo compartment at a second discharge rate after at least a portion of the fire suppressant from the first fire-suppressant vessel assembly has been discharged, the second discharge rate being less than the first discharge rate; and

a third fire-suppressant vessel assembly configured to discharge fire suppressant into the cargo compartment at a third discharge rate greater than the second discharge rate, at least a majority of the fire suppressant from the third fire-suppressant vessel assembly being discharged only during descent of the aircraft.

[c19] 19. The system of claim 18 wherein a portion of the fire suppressant from the second fire-suppressant vessel assembly being discharged into the compartment simultaneously with discharge of the fire suppressant from the third fire-suppressant vessel assembly into the compartment during the descent of the aircraft.

[c20] 20. An aircraft, comprising
a fuselage having a cargo compartment;
a fire-detection system coupled to the cargo compartment and activatable upon detection of a fire condition; and
a fire-suppression system coupled to the fire-detection system and to the cargo compartment, the fire-suppression system comprising:
at least one fire-suppressant vessel;
a discharge conduit coupled to the at least one fire-suppressant vessel; and
a valve arrangement coupled to the at least one fire-suppressant vessel and the discharge conduit, the valve arrangement having a first setting to discharge a fire suppressant to the compartment at a first discharge rate upon activation of the

fire-suppression system, a second setting to discharge the fire suppressant to the compartment at a second discharge rate less than the first discharge rate, and a third setting to discharge the fire suppressant to the compartment at a third discharge rate greater than the second discharge rate during descent of the aircraft.

[c21] 21. The aircraft of claim 20, further comprising a first container containing at least a first portion of the fire suppressant, a second container containing at least a second portion of the fire suppressant, and a third container containing at least a third portion of the fire suppressant.

[c22] 22. The aircraft of claim 20 wherein the fire-suppressant vessel contains Halon.

[c23] 23. The aircraft of claim 20 wherein the valve arrangement is configured to discharge the fire suppressant at the first discharge rate over a first period of time, to discharge the fire suppressant at the second discharge rate over a second period of time greater than the first period of time, and to discharge the fire suppressant at the third discharge rate over a third period of time less than the second period of time.

[c24] 24. The aircraft of claim 20 wherein the valve arrangement includes a first flow control device coupled to the discharge conduit to control a flow of the fire suppressant at the second discharge rate, and a second flow control device coupled to the discharge conduit to control at least a portion of a flow of the fire suppressant for dispersal at the third discharge rate.

[c25] 25. An aircraft, comprising:
 a fuselage having a cargo compartment; and

a fire-suppression system coupled to the cargo compartment, the fire-suppression system comprising:

means for containing a fire suppressant;

means for carrying a flow of the fire suppressant to the cargo compartment from the means for containing; and

a means for controlling the flow of fire suppressant for discharge into the cargo compartment, the means for controlling having a first setting to discharge the fire suppressant at a first discharge rate, a second setting for discharging the fire suppressant into the compartment at a second discharge rate greater than the first rate, and a third setting for discharging the fire suppressant into the compartment at a third discharge rate greater than the second discharge rate during descent of the aircraft.

[c26] 26. An aircraft, comprising

a fuselage having a cargo compartment;

a warning system coupled to the cargo compartment and activatable for a flight portion having an initial phase, an intermediate phase, and a descent phase; and

a fire-suppression system coupled to the warning system and to the cargo compartment, the fire-suppression system having:

at least one fire-suppressant vessel containing fire suppressant;

a first flow restricting device coupled to the fire-suppressant vessel and configured to control discharge of the fire suppressant into the compartment at a first discharge rate;

a second flow restricting device coupled to the fire-suppressant vessel and configured to control discharge of the fire suppressant into the compartment at a second discharge rate less than the first discharge rate; and

a third flow restricting device coupled to the fire-suppressant vessel and configured to control discharge of the fire suppressant into the compartment at a third discharge rate less than the first discharge rate and greater than the second discharge rate.

[c27] 27. A method of suppressing a fire condition in a cargo compartment of an aircraft, comprising:

detecting a condition in the cargo compartment during flight of the aircraft;
delivering a first quantity of fire suppressant into the cargo compartment at a first discharge rate after detecting the condition;
delivering a second quantity of fire suppressant into the cargo compartment at a second discharge rate less than the first discharge rate after delivering the first quantity of fire suppressant; and
delivering a third quantity of fire suppressant into the cargo compartment at a third discharge rate greater than the second discharge rate and during descent of the aircraft.

[c28] 28. The method of claim 27 wherein delivering the first quantity includes delivering fire suppressant from a first container, delivering the second quantity includes delivering the fire suppressant from a second container, and delivering the third quantity of fire suppressant includes delivering the fire suppressant from a third container different from the second container.

[c29] 29. The method of claim 27 wherein delivering the third quantity of fire suppressant includes providing a fire-suppressant concentration in the cargo compartment at a generally constant level during the descent of the aircraft.

[c30] 30. The method of claim 27 wherein delivering the second quantity of fire suppressant includes providing a fire-suppressant concentration in the cargo

compartment above a minimum level prior to descent of the aircraft, and delivering the third quantity of fire suppressant includes adding fire suppressant into the cargo compartment to provide the fire-suppressant concentration during descent of the aircraft.

[c31] 31. The method of claim 27 wherein delivering the second quantity of fire suppressant includes providing a fire suppressant concentration in the cargo compartment above a minimum level prior to descent of the aircraft, and the delivering of the third quantity of fire suppressant includes providing a quantity of fire suppressant into the cargo compartment of the aircraft to maintain the fire-suppressant concentration in the cargo compartment throughout the descent of the aircraft.

[c32] 32. The method of claim 27, further comprising controlling the delivery of the second quantity of fire suppressant with a first flow restricting device, and controlling the delivery of the third quantity of fire suppressant with a second flow restricting device.

[c33] 33. A method of suppressing a fire condition in a cargo compartment of an aircraft, comprising:

detecting a condition in the cargo compartment during flight of the aircraft;
delivering a first volume of fire suppressant into the cargo compartment upon detection of the condition in the compartment to provide a first concentration level of the fire suppressant in the cargo compartment;

delivering a second volume of the fire suppressant into the cargo compartment at a first discharge rate after delivery of the first fire suppressant to provide a second concentration level of the fire suppressant in the cargo compartment; and

delivering a third volume of the fire suppressant into the cargo compartment during descent of the aircraft to provide the second concentration level of the fire suppressant substantially throughout descent of the aircraft.

[c34] 34. The method of claim 33, further comprising controlling the delivery of the third volume of fire suppressant with a flow restricting device.

[c35] 35. The method of claim 33, further comprising controlling the delivery of the second volume of fire suppressant with a first flow-restricting device, and controlling the delivery of the third volume of fire suppressant with a second flow-restricting device.